

【Grant-in-Aid for Specially Promoted Research】
Science and Engineering (Mathematics/Physics)



Title of Project : New phase of Ocean Hemisphere Project: Imaging the normal oceanic mantle by advanced ocean bottom observations

Hisashi Utada
(The University of Tokyo, Earthquake Research Institute,
Professor)

Research Area : Earth and planetary science, Solid Earth and planetary physics

Keyword : Ocean bottom geophysical observations, oceanic mantle

【Purpose and Background of the Research】

The oceanic mantle is an important region to understand the Earth system, as more than 2/3 of the Earth surface is covered by oceanic area. In the ‘normal oceanic mantle’ between mid oceanic ridge and subduction zone in particular, there remain a couple of most fundamental questions in Earth science.

First question is the cause of asthenosphere, which is a soft (fluid) layer below oceanic plate (lithosphere). Plate tectonics is based on a concept that a rigid lithosphere moves over a weaker asthenosphere, and thus the precise knowledge of its fluidity is fundamental to understand how our planet works.

The presence of water is one of the properties characterizing the planet Earth. Second question is the amount of water in the mantle transition zone, which is essential to understand the Earth’s total water budget. The question may never be fully solved without the knowledge for the “normal oceanic mantle” that occupies the largest part of the entire mantle.

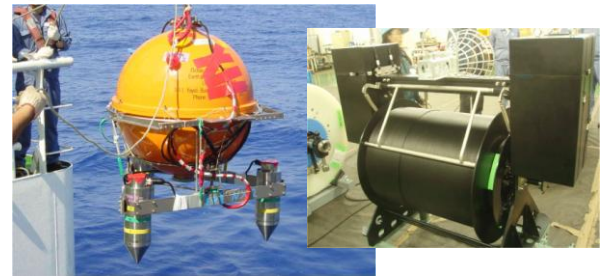
In the present project, we aim to solve these two fundamental problems from observational approach, by using advanced ocean bottom geophysical instruments that were originally developed by our group.

【Research Methods】

Physical conditions of the oceanic mantle in our concern will be investigated based on the structural images which are obtained by ocean bottom seismological and electromagnetic (EM) observations. The combination of seismological and EM parameters enables us accurate estimation of the conditions. We plan to deploy new seismometers and electrometers (see attached photos), as well as ordinary ocean bottom instruments which were also developed by ourselves, on the ‘normal ocean floor’ in the northwestern Pacific for 2-3 years.

Our new seismometer enables us to measure horizontal ground motions at a noise level comparable to that at land stations, which has so far been hard for ocean bottom instruments. Our new electrometer also

reduced the electric field noise significantly. Thus we are able to extract various kinds of information on the normal oceanic mantle by applying a wide variety of analysis methods.



【Expected Research Achievements and Scientific Significance】

The present project is expected to make two important contributions to the solid Earth science community in the world. One is made by providing clear scientific results to answer the two fundamental questions on the normal oceanic mantle as described above. The other can be made by thus displaying a new scientific approach to understand the mantle dynamics, which will introduce a new infrastructure and induce a new trend in Earth science.

【Publications Relevant to the Project】

- (1) Utada, H., et al., (2009) A joint interpretation of electromagnetic and seismic tomography models suggests the mantle transition zone below Europe is dry, *Earth Planet. Sci. Lett.*, **281**, 249-257.
- (2) Kawakatsu, H., et al., (2009), Seismic Evidence for Sharp Lithosphere-Asthenosphere Boundaries of Oceanic Plates, *Science*, **324**, 499-502.

【Term of Project】 FY2010-2014

【Budget Allocation】 429,600 Thousand Yen

【Homepage Address and Other Contact Information】

<http://www.eri.u-tokyo.ac.jp/yesman/>